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***IP Architectures and Solutions***

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**School of Advanced Technology**

<b>Course Number:</b> NET3012	<b>Contribution to Program:</b> Core	<b>Educator(s):</b> Michael Anderson
<b>Applicable Program(s):</b> Bachelor of Information Technology – Network Technology	<b>AAL:</b> 06	<b>Approved For:</b> Winter 2017
<b>Course Hours:</b> 5 contact hours per week	<b>Prerequisites:</b> NET3008	<b>Approved By:</b>
	<b>Corequisites:</b> None	
		<b>Approved for Academic Year:</b> 2016-2017

**COURSE DESCRIPTION**

An exploration of various deployment options that can be implemented atop an IP network core. The focus will be on techniques, technologies or architectures that serve to enhance IP delivery and connectivity, or provide services leveraging an IP infrastructure.

## COURSE CURRICULUM

### I. Course Learning Requirements/Embedded Knowledge and Skills

Essential Course Learning Requirements	Knowledge and Skills
<p><b>To earn credit for this course, you must reliably demonstrate your ability to:</b></p> <ul style="list-style-type: none"> <li>○ Effectively implement &amp; deploy advanced configurations on carrier-grade routers.</li> </ul>	<ul style="list-style-type: none"> <li>– CLI access for Nokia SR7750 equipment</li> <li>– Configuration of interfaces and standard L3 routing: system &amp; loopback interfaces, OSPF, MPLS, and BGP on Nokia SR7750 equipment</li> <li>– demonstrating practical lab skill at consistently and accurately designing, deploying and troubleshooting configurations on actual equipment is an essential requirement</li> </ul>
<ul style="list-style-type: none"> <li>○ Explain and implement MPLS fundamentals: LSPs and LDP.</li> </ul>	<ul style="list-style-type: none"> <li>– Static and dynamic labels</li> <li>– Configuration, verification, and troubleshooting of LSPs</li> <li>– Configuration of LDP for dynamic LSPs</li> <li>– demonstrating practical lab skill at consistently and accurately deploying suitable configuration(s) on actual equipment is an essential requirement</li> </ul>
<ul style="list-style-type: none"> <li>○ Explain the design goals and underlying principles of MPLS tunnels, L1, L2, L3 VPNs.</li> <li>○ Prepare and implement the network infrastructure for VPNs</li> <li>○ Effectively implement Layer 2 and 3 VPNs</li> </ul>	<ul style="list-style-type: none"> <li>– Configuration, verification, and troubleshooting of MPLS</li> <li>– Configuration, verification, and troubleshooting of VPWS, VPLS and VPRN services</li> <li>– demonstrating practical lab skill at consistently and accurately deploying suitable configuration(s) on actual equipment is an essential requirement</li> </ul>
<ul style="list-style-type: none"> <li>○ Demonstrate a clear understanding of the design goals and underlying principles of Traffic Engineering, the RSVP protocol, and RSVP-TE</li> <li>○ Demonstrate the ability to successfully configure RSVP-TE</li> </ul>	<ul style="list-style-type: none"> <li>– Configuration, verification, and troubleshooting of RSVP and TE</li> <li>– demonstrating practical lab skill at consistently and accurately deploying suitable configuration(s) on actual equipment is an essential requirement</li> </ul>
<ul style="list-style-type: none"> <li>○ Demonstrate a clear understanding of the design goals and underlying principles of secondary LSPs and Fast Re-Route</li> </ul>	<ul style="list-style-type: none"> <li>– Configuration, verification, and troubleshooting of FRR on carrier-grade routers</li> <li>– demonstrating practical lab skill at consistently and accurately deploying suitable configuration(s) on actual equipment is an essential requirement</li> </ul>
<ul style="list-style-type: none"> <li>○ Understand and explain key concepts for Software Defined Networking (SDN) and compare &amp; contrast with VPN implementations</li> </ul>	<ul style="list-style-type: none"> <li>– Protocols and methods for implementing SDN</li> <li>– Differentiate customer controlled vs provider controlled IP architectures</li> </ul>

### II. Learning Resources

#### Required Textbooks:

Alcatel-Lucent Network Routing Specialist II (NRS II) Self-Study Guide, by Glenn Warnock & Amin Nathoo, Wiley, 2011, ISBN: 978-0-470-94772-2 / 978-1-118-17813-3

Service Architecture (SA); Multi-Protocol Label Switching (MPLS), course texts from Nokia.

All the above books are provided to each student in pdf format. The NRS II ebook is in Adobe Digital Edition (ADE) format; students will need an Adobe ID and the Adobe Digital Editions software to obtain access to the book.

### **Suggested Reference Books:**

The following book is suggested to enhance your learning, but is NOT a required text.

Alcatel-Lucent Scalable IP Networks Self-Study Guide by Kent Hundley, Wiley Press 2009, ISBN: 978-0-470-42906-8

### **Lab Notebook:**

During lab periods, you will be expected to have and maintain a separate lab notebook to manually record anything you may need to repeat or recall in the future. Some lab exercises may instruct you to record information in your lab notebook for future reference in follow-on labs. If you are involved in a troubleshooting exercise, the lab book will be particularly valuable for recording any issues, your diagnostic and corrective actions and the ensuing results. Proper documentation is a critical aspect of an effective problem solving methodology.

### **Functioning IT Account:**

You need a functioning Algonquin IT account to do work required for this course, sometimes while in the lab. **Make sure you have a functioning IT account!**

### **Required Equipment:**

Each student will require:

- a USB memory stick. Students will need to backup and/or save results of their lab work, and will need a USB stick to do so.

Course activities are predicated on the use of the “Required Equipment” as stipulated, using the college-supplied software image, within the scheduled lab. Students attempting to use other hardware, platforms, etc. do so at their own risk

## **III. Teaching/Learning Methods**

The course consists of 5 contact hours per week in a mixture of lectures and hands-on lab sessions. It is anticipated that you will need to spend at least an additional 3 - 6 hours per week, outside of that for readings, assignments and further study/research.

During this course you are likely to experience:

### **Classroom Lectures:**

The classroom lectures will cover the core relevant material in each chapter of the required textbook, expanding on some of the topics presented while reviewing in more detail, other important concepts.

It is important to follow the theory sessions closely as they carry & expand the “knowledge” thread for the

course, and are structured in a way to ensure intuitive and durable learning.

Certain topic areas will be briefly presented in “big picture terms” in the earlier lectures and then revisited in more depth later on in subsequent lectures or semesters.

Lectures will present part of the theoretical material of the course. Students are expected to attend all of the lectures. Students are encouraged to ask questions during lectures and to consult with the professors on topics, which they do not clearly understand. Professors will inform students, at the beginning of the course, of suitable times for consultations.

### **Field Trip:**

A field trip to visit a local networking company will be used to exemplify and illustrate the relevance of the course material to current industry trends and practices. The company will be selected based on the extent of their R&D and products relevant to course material. Students should consider attendance at the field trip as an integral and mandatory part of the course. Quiz, test, and final exam questions may be based on knowledge gained during the field trip.

### **Labs:**

The labs are the hands-on component of the course, allowing students to apply relevant portions of the theoretical material in a more concrete way.

It is also important to follow the lab sessions closely as they are not necessarily synchronized to the theory lectures at all times during the semester. The lab sessions are structured as independent stand-alone learning opportunities that *complement* the theory portion of the course.

Students are expected to perform initial analysis and design **before** their scheduled lab, in order to take advantage of the limited lab time. Laboratory assignments will be integrated with the theory material. The students' ability to successfully complete the assigned exercises will directly correlate with their level of success on tests and the final exam.

While the text references and lectures constitute major sources of information for this course, additional information such as pdf format course notes posted on the course website, Internet references, exercises, lab worksheets and other material will be provided as required.

This course requires you to learn material in the following broad areas listed below, and the organization of the theory and lab portions of the course will reflect this division of learning.

- A. Concepts related to “how it works”, “why it's necessary”, “where/when it's used”.
- B. Standards & practices related to applying the knowledge & technologies to achieve certain results.
- C. Recognizing relevant and valid applications of the technology, and knowing what to expect from them.
- D. Ways and means of dealing with malfunctioning networks.
- E. Evolutions and trends related to all the above.
- F. The acronyms and technical jargon associated with all of the above.

#### IV. Learning Activities

Samples of learning activities may include:

- Self-directed reading and research (text and online materials)
- Lectures in-class or online
- In-class quizzes
- Assigned laboratory work, individually or in groups
- Preparing and practicing for labs using Nokia's "MySRLab" remote-access facility
- Individual homework assignments
- In-class exercises, individually or in groups

#### V. Course Content

It is anticipated that course topics will be covered according to the following week-by-week schedule, though the professor reserves the right to make adjustments as deemed necessary:

Week(s)	Topic
1	Intro & overview of MPLS, labels, label switching
2	Labels, LSPs, LDP
3	LDP in depth
4	RSVP
5	RSVP & Traffic Engineering part 1
6	Traffic Engineering part 2, and MPLS Shortcuts
7	Review, Midterm test
8	Intro & Overview of VPNs, SAP, SDP
9	L2 VPN: VPLS
10	RSVP-TE resiliency; secondary LSPs; Fast re-route (FRR); L3 services: IES
11	L3 services: VPRN
12	Review
	Lab Exam: Skills Based Assessment

#### VI. Evaluation/Earning Credit:

The following will provide evidence of your learning achievement:

Assessment of student learning will be done by means of class and online tests, final exam and laboratory activities that include a “practical” lab test.

Laboratory attendance is compulsory, and absence from three or more laboratory sessions without the prior consent of the professor will result in a final grade of “F”. Students are responsible for keeping a record of the number of laboratory sessions they have missed. Your teacher is not responsible for informing students of an impending failure because of missed laboratory sessions.

The ICT Department requires that all course assignments (homework exercises, laboratory work, projects, etc) be submitted by students using a standard which could be specific to one or more courses. Professors will ensure, at the beginning of the term, that students are advised of the exact details of these course specific submission requirements. Professors will also post them online alongside the course outline. Student submissions that do not meet the course published submission standards may not be marked, and may incur a penalty of up to 100% of the submission mark.

All laboratory assignments must be successfully completed in order to obtain course credit. Late assignments will be penalized and receive a mark of zero, but must still be completed. Any evaluation aspects missed will result in a grade of “0” for that item. In the case of a documented emergency or prior arrangement, the professor, in consultation with the Chair, will determine how the marks will be made up and/or final grade adjusted.

All students are required to write the final exam. If, as a result of being off-track in your program, you note that there is a scheduling conflict in your final exam schedule, it is your responsibility to alert your course professor no later than one week before the start of the final exam period, to allow for any special arrangements. For any other situations resulting in a student not writing their final exam, the normal Carleton University rules for missed final exams will apply. See the following link for details: <http://carleton.ca/registrar/special-requests/deferral/>

All students are required to write the Practical Lab test. It is specifically an assessment of speed and accuracy in performing the essential duties and requirements of network configuration and management, and is the means by which students demonstrate mastery of core aspects of the course curriculum: correctly and reliably completing this work is a vital, indispensable part of both this course and network engineering. The designation of the practical lab skills as an essential requirement and duty (as defined by section 17(1) of the Ontario Human Rights Code R.S.O. 1990) derives from the fact that functional network access, and restoring that access should it ever fail, is now widely understood as a time-sensitive, mission critical resource. Please see section I "Course Learning Requirements/Embedded Knowledge and Skills" for items comprising the essential requirements. Accordingly, only under clearly exceptional circumstances will requests for extended time on the Practical Lab test be considered, and all such requests must be made well in advance of the test date. Any students seeking accommodations should review the relevant legislation, and are reminded that they "must still be *able* to perform the essential requirements" and "*successfully* meet the essential requirements of the program, with *no alteration in standards or outcomes*" (*Guidelines on accessible education*, Ontario Human Rights Commission, ISBN: 0-7794-7191-1)

The factors determining the final grade are:

<b>1. Tests, Quiz &amp; Final Examination</b>		<b>65%</b>
Formative Assessments	35%	
- Midterm Test(s)		
- In-class Quizzes & Exercises		
Final Examination	30%	
<b>2. Lab Evaluation</b>		<b>35%</b>
Lab Exercises	10%	
- Write-ups		
- Case Study (if assigned during the semester)		
Practical lab test	25%	

In order to obtain a credit for this course, students **must** achieve a minimum contribution of:

- ½ the marks from **Evaluation Item #1** (ie. theory portion of the course)
- ½ the marks from **Evaluation Item #2** (ie. practical portion of the course)

Equivalency credit *may* be given for relevant portions of the lab work for students who have obtained certifications in the Nokia SRC NRS-II program.

## **Lab Evaluation Details**

Lab evaluation is conducted by the lab professor, and contributes significantly to your final grade. For this course, the following criteria must be satisfied in order to obtain a non-zero lab mark:

1. Satisfactory attendance and participation in the lab.
2. Satisfactory workmanship and behaviour in the lab.
3. Satisfactory adherence to rules prescribed for the lab facility.
4. Being prepared and equipped for lab work while in the lab.
5. Satisfactory completion of the work required within the lab period.
6. Satisfactory completion of any exercises and projects outside of lab hours.

**Where there is a requirement for group work and/or sharing of hardware within a group, the lab professor reserves the right to reorganize/stipulate group memberships and to suspend or deny further access to the lab at any time if attendance and participation criteria are not being met. No allowances are made in the course for students whose access to the lab is suspended or denied for disciplinary reasons.**

## **VII. Related Information**

**Retention of course material.** It is your responsibility to retain copies of all assignments, labs and mid-term tests (returned from the professor), and any other evaluations and pertinent records (except for final exams, which are not returned) in case you become involved in an appeal hearing at a later date.

It is also your responsibility to retain course outlines for possible future use to support applications for transfer of credit to other educational institutions.

**College email account.** Algonquin College provides all full-time students with an email account. This is the address that will be used when the College, your professors, or your fellow students communicate important information about your program or course events. It is your responsibility to ensure that you know how to send and receive email using your Algonquin College account, and to check it regularly.

**Harassment/Discrimination/Violence will not be tolerated.** Any form of harassment (sexual, racial, gender or disability-related), discrimination (direct or indirect), or violence, whether involving a professor and a student or amongst students, will not be tolerated on the college premises.

Harassment means one or a series of vexatious comment(s) (whether done verbally or through electronic means), or conduct related to one or more of the prohibited grounds that is known, or ought reasonably to be known, to be unwelcome/unwanted, offensive, intimidating, derogatory or hostile.

This may include, but is not limited to: gestures, remarks, jokes, taunting, innuendo, display of offensive materials, offensive graffiti, threats, verbal or physical assault, stalking, slurs, shunning or exclusion related to the prohibited grounds.

Bachelor of Information Technology students are bound by the “Academic Regulations of the University – Student Conduct”, “13. Offences of Conduct: Discrimination and Harassment” detailed within Carleton University’s Undergraduate Calendar, and online at:

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv15/>

**The School of Advanced Technology's Standard Operating Procedure on Plagiarism and Academic Honesty** defines plagiarism as an attempt to use or pass off as one's own idea or product, work of another without giving credit. Plagiarism has occurred in instances where a student either directly copies another person's work without acknowledgement; or, closely paraphrases the equivalent of a short paragraph or more without acknowledgement; or, borrows, without acknowledgement, any ideas in a clear and recognizable form in such a way as to present them as one's own thought, where such ideas, if they were the student's own would contribute to the merit of his or her own work.

Plagiarism is one of the most serious academic offences a student can commit.

Bachelor of Information Technology students are bound by the "Academic Regulations of the University - 14.0 Academic Integrity" detailed within Carleton University's Undergraduate Calendar, and online at:

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv14/>

### **Violation of the Copyright Act.**

- **General** – The Copyright Act makes it an offence to reproduce or distribute, in whatever format, any part of a publication without the prior written permission of the publisher. For complete details, see the Government of Canada website at <http://laws.justice.gc.ca/en/C-42>. Make sure you give it due consideration, before deciding not to purchase a textbook or material required for your course.
- **Software Piracy** - The Copyright Act has been updated to include software products. Be sure to carefully read the licensing agreement of any product you purchase or download, and understand the term and conditions covering its use, installation and distribution (where applicable). Any infringement of licensing agreement makes you liable under the law.

**The Use of Electronic Devices** during classes, other than those sanctioned by the course professor is strictly prohibited. In particular, cell phones are not to be used to communicate during a class. The use of any electronic devices during exams and mid-term tests, other than those sanctioned by the faculty in charge of the examination is strictly prohibited.

In accordance with College Directive E39, any unauthorized use of a prohibited device will be considered plagiarism, and be dealt with as such. In these cases, Bachelor of Information Technology students would be bound by the "Academic Regulations of the University - 14.0 Academic Integrity" detailed within Carleton University's Undergraduate Calendar, and online at: <http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv14/>

**Disruptive Behaviour** is any conduct, or threatened conduct, that is disruptive to the learning process or that interferes with the well-being of other members of the College community. It will not be tolerated.

Members of the College community, both students and staff, have the right to learn and work in a secure and productive environment. The College will make every effort to protect that right.

Incidents of disruptive behaviour must be reported in writing to the departmental Chair as quickly as possible. The Chair will hold a hearing to review available information and determine any sanctions that will be imposed. Disciplinary hearings can result in penalties ranging from a written warning to expulsion.

For further details, consult Algonquin College Directive – E27, Instaguide.

**Students with Disabilities** requiring academic accommodations in this course are encouraged to contact a coordinator at the Paul Menton Centre (PMC) for Students with Disabilities to complete the necessary *letters of accommodation*. After registering with the PMC, make an appointment to meet and discuss your needs with the professor at least two weeks prior to the first in-class test or instructional television midterm exam. This is necessary to ensure sufficient time for making any needed arrangements. Please note the deadline for submitting completed forms to the PMC as published in Carleton University's "Academic Year" calendar.

### **Challenge for Credit**

Challenge for credit is a Carleton University policy that enables students to obtain undergraduate academic credit for any learning and experience gained through work and related professional development. It is not intended to overlap in scope with transfer of credits or admission with advanced standing.

For full details, see Carleton University's Undergraduate Calendar, "Academic Regulations of the University", Section 1.9, also available online at:

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv1/#1.9>

For this course, candidates will provide evidence of their learning achievement through the successful completion of:

- A challenge exam with a breadth of coverage and level of difficulty equivalent to the final examination in the course; plus,
- A hands-on or practical component to demonstrate the achievement of the requisite applied knowledge and skills.

### **Eligibility for Deferred Examination**

Only students who have achieved satisfactory performance during the term will be eligible for a deferred examination. In accordance with the factors determining the final grade in section VI above, satisfactory performance leading to the final exam is defined as the student having achieved 50% in all aspects of the course marking scheme (save the final exam), be they grouped (e.g. practical component, lab component, theory component, etc) or individually listed.

Students who have failed the course on the basis of inadequate term course work will receive a grade of FND – failure with no deferred final examination allowed.